IN WHAT OPERATIONS IN ARITHMETIC SHOULD A PUPIL BE REQUIRED TO UNDERSTAND THE REASONS FOR THE STEPS TAKEN? IN WHAT OPERATIONS SHOULD SUCH A REQUIREMENT BE POSTPONED TO A MATURER AGE?

By A. M. Curtis.

Our subject is in the form of a question demanding an answer. *No definite answer can ever be given in the form of a rule to be followed in teaching children.* Children differ so widely in natural aptitude and in rates of development that work adapted to one third of a grade of pupils is not suitable for the remainder of the grade.

It is for this reason that I claim that no definite rule can obtain and that all is finally dependent on the teacher's judgment brought to bear on the needs of the individuals of a class regardless of "grade."

I am, therefore, driven away from my ideals when I begin to discuss our question from that most unsatisfactory platform —the best for the average.

It is one thing to ask a pupil to *do* in arithmetic. It is quite another thing to ask for an expression of the underlying argument which gives him his rule for the performance of his process.

The *complete* understanding of the four processes with integers is beyond a child's comprehension. And it is not necessary that he know the whole theory of the work in order to glean for himself what he does need—namely, speed and accuracy in the doing. With fractions, the case is different. The idea of fractions brings the need of illustration that the pupil may comprehend the language of the subject, and grow in appreciation of the ratio concept and the different units which fractions involve. Here the reasoning element is brought into prominence through an appeal, through the senses, to the proportion in things, the sizes of units. It is only by continued exercises of such nature that the abstraction takes lodgment.

The changes in fractions known as reductions, the necessity for like units in adding, and the like, are cases in point.

Decimal fractions and their relations to common fractions and per cents are not taught in a day. One learns to know their true relation and significance by repeated use, and emphasis on proper *reading* and *habit of thinking* as their application broadens.

But here as elsewhere in mathematics the new idea is one of appreciation—not of truth alone, but of a shorthand, compact notation, wise and useful, yet not void of difficulties in its acquirement. Here pupils must know and know thoroughly. And here, too, the reasoning is best learned through repeated contact in varied application to reality: approximating, proving, expressing the ideas in definite forms in logical order, and then learning to jump the details and fly to the conclusion.

The position of the decimal in the product is illustrative of this period of arithmetic's growth.

To multiply 1201.5 by .015, for example. If pupils *read, really read,* their rule is made clear. They must say *fifteen thousandths of.* What does *fifteen thousandths of* mean? Answer the question and the product's "decimal point" is placed by $15 \times 1\text{-}1000$ of 1201.5 or 15×1.2015.

Such analysis can not be forced on children. They come to an understanding of it slowly in a majority of cases. They can, however, all be taught to *do,* should be so taught, and at the same time carefully trained to *read deeply,* that is, with deepening appreciation of words' meanings.

It is not all *do,* nor is it formal demonstrative reasoning on the part of the pupil that will win the day for him—our unfortunate "average."

I like the following plan of treatment for every subject in arithmetic as suited to our classes in public schools:

Explain by genetic mode of teaching each step and process presented in very simple, brief form—so as to appeal to the eye in strikingly clear arrangements. Follow with much drill and practice. In a week, present the whole subject again; drill and practice. And again and again present it. Let every teacher in succeeding grades present it.

It is by such repetition only that the slowly developing pupil

gains his understanding. The precocious pupil had his due in the first round of explanation.

Such a plan gives *every* pupil a fair chance, makes the work show all pupils that rules do not come into existence in haphazard fashion, but are expressions of the working out of principles and related thought. It stimulates to clear thinking and yet does not lose sight of the practical phase—do accurately and speedily business arithmetic.

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TAKE JOY HOME.

Take joy home,
And make a place in thy great heart for her,
And give her time to grow, and cherish her,
Then will she come and oft will sing to thee,
When thou art working in the furrows; aye,
Or weeding in the sacred hour of dawn.
It is a comely fashion to be glad:
Joy is the grace we give to God.

—*Jean Ingelow*